BENCHMARKING INFORMATION TECHNOLOGY UTILIZATION IN THE CONSTRUCTION INDUSTRY IN JORDAN

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SUMMARY: *This paper reports the findings of conducting a modified version of the IT barometer survey in the construction industry in Jordan. The study collects data from 207 firms. Thirty-four percent of these firms are general contractors, 37% are architecture and engineering firms, 19% are consulting and architecture and engineering firms, and 10% are consulting firms. The participating firms are involved in the construction of buildings, roads and bridges, water and sewage projects, and electromechanical projects. The size of firms in terms of number of employees varies widely with some firms have only one employee, while other firms have over 150 employees. The study shows that there is a 0.46 desktop computer and a 0.024 laptop computer per employee. Among the top software utilized by the industry are Word, Excel, web browsers, and e-mail. AutoCad dominates the production of engineering drawings with most firms utilize the software almost 100% of the time. Eighty-two percent of firms have increased their IT investment in the last two years. Eighty-five percent are committing more dollars to invest in IT in the next two years. According to 92% of respondents, demands from customers are a very important motivator for new IT investment. The perceived benefits for IT adoption according to the respondents are better quality of work, work done more quickly, better financial control, better communications, faster and simpler access to common data, greater felxibility to satisfy customers, possibility of sharing common information, easier to use lots of data, and possibility of telecommuting. The main obstacles for IT use are investment costs too high and greater know-how required from staff. In conclusion, this paper benchmarks the current IT usage, availability, and perceived impact in the construction industry in Jordan. Such benchmarking is of prime importance to both construction education and practice to understand current trends, forecast future directions, and conduct international comparisons.*

KEYWORDS: *information technology, construction, benchmarking, survey, Jordan.*

1. INTRODUCTION

In recent years, Jordan has embarked upon an ambitious plan to make full use of the information technology capabilities. The purpose of this study is to benchmark current IT usage, availability, and perceived impact in the construction, architecture and engineering, and consulting industry in Jordan. In particular, the paper reports the findings of conducting a modified version of the IT barometer survey.

The IT-barometer survey was developed by Samuelson (1998). Samuelson (2002) explains that the IT-barometer survey is designed to be repeatable over time, comparable between countries, and covers all categories of construction companies. Since its initiation, the IT-barometer survey was conducted in several countries: Finland, Denmark, and Sweden (Howard et al., 1998); Canada (Rivard, 2000); and Singapore (Hua, 2005).

The current study collects data from 207 firms. Thirty-four percent of these firms are general contractors, 37% are architecture and engineering firms, 19% are consulting and architecture and engineering firms, and 10% are consulting firms. The participating firms are involved in the construction of buildings, roads and bridges, water and sewage projects, and electromechanical projects.

The study contributes a valuable benchmark to understand current IT trends in the construction industry in Jordan, forecast future directions, and conduct international comparisons. The paper unfolds as follows: research methodology, results and analysis, and conclusions.

2. RESEARCH METHODOLOGY

Both Jordan Contractors Association and Jordan Engineers Association were contacted for potential participation of their members in the study. Two-hundred and fifty firms were randomley selected from memeber lists of both associations. Out of these 250 firms, 207 firms agreed to participate in the interview questionnaire, while 37 firms declined participation.

The participating firms were interviewed during the period of June 2004 and January 2005. As mentioned earlier, the interview questionnaire utilized in the study is a modified version of the IT-barometer survey. The interviewees are general managers, managers, architects, and engineers.

3. RESULTS AND ANALYSIS

This section presents the results and analysis of the survey. The study collected data from 207 firms. As shown in Fig. 1, 34% of the participating firms are general contractors, 37% are architectural and engineering firms, 19% are consulting and architectural and engineering firms, and 10% are consulting firms.

The size of the participating firms in terms of number of employees varies widely as shown in Fig. 2. Forty-seven percent of the participating firms have less than 5 employees, 37% have between 5 and 10 employees, 13% have 11 to 50 employees, 2% have 51 to 150 employees, and 1% has over 150 employees.

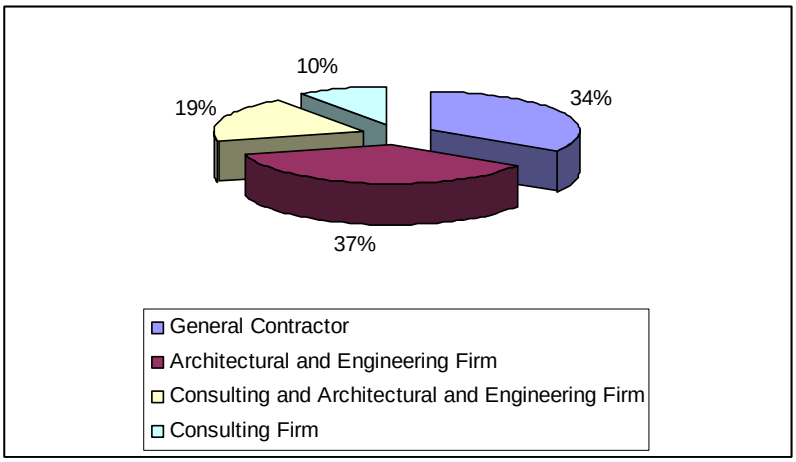

FIG. 1: Types of participating firms

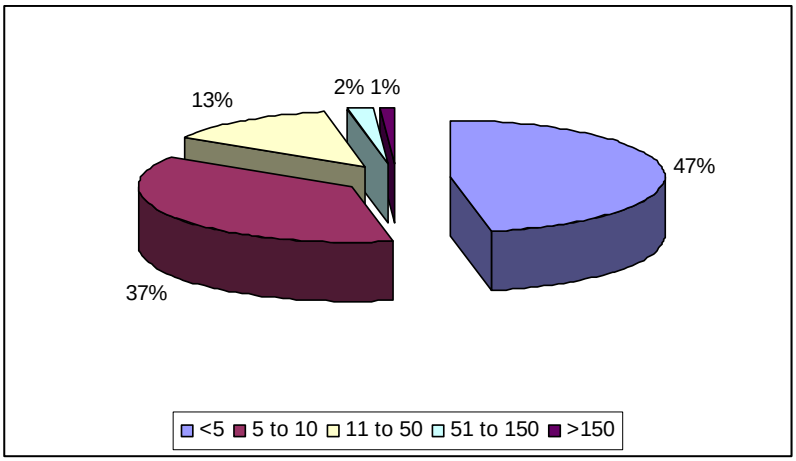

FIG. 2: Number of employees

The respondents were asked to indicate the number of desktops and laptops at their firms. Only 3.2% of firms do not have computers. Table 1 shows number of dektops and laptops per employee. The industry average is 0.46 desktop per employee and 0.026 laptop per employee. General contractors have the lowest number of computers

per employee, while consulting and architectural and engineering firms have the highest number of computers per employee.

TABLE 1: Number of desktops and laptops per employee

	General Contractors	Architectural and Engineering Firms	Consulting and Architectural and Engineering Firms	Consulting Firms	Industry Average
Desktop per employee	0.35	0.61	0.61	0.48	0.46
Laptop per employee	0.017	0.042	0.048	0.028	0.026

Fig. 3 shows software utilization by the industry. Over 85% of firms utilize Word and Excel. About two-thirds of the participating firms use web browsers and e-mail. Structural analysis software like Prokon and Staad are utilized by approximately one-third of firms. Primavera is utilized by more firms in the industry compared to MS Project. Thirty-one percent of firms use Primavera compared to13% only use MS Project. Photoshop is the least utilized software by the industry with only 10% of firms report using it.

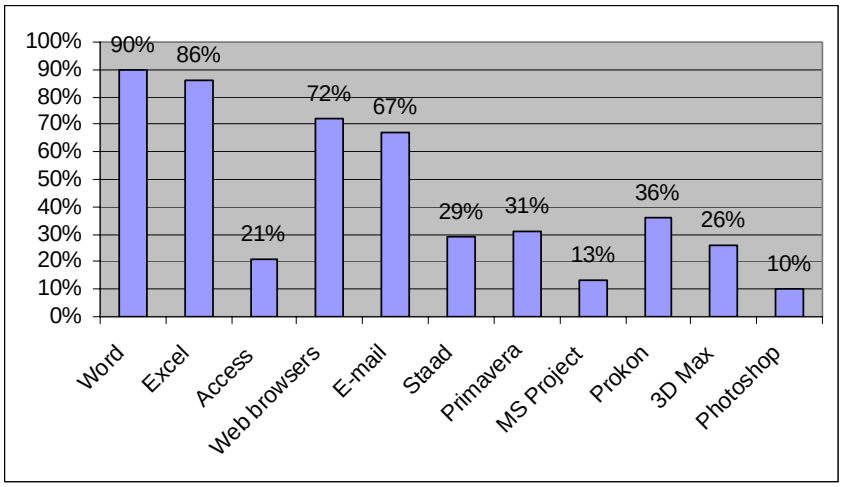

FIG. 3: Software utilization

Table 2 shows software use by the industry according to types of firms. General contractors make more use of Word, Excel, Primavera, and MS project compared to the rest of the industry. Web browsers and e-mail are approximately equally utilized by the industry. Design software like Prokon and 3D Max are least utilized by general contractors compared to the rest of the industry.

TABLE 2: Software utilization broken by types of firms (%)

	General Contractors	Architectural and Engineering Firms	Consulting and Architectural and Engineering Firms	Consulting Firms
Word	94	90	90	80
Excel	97	82	74	80
Access	24	18	23	15
Web browsers	76	68	72	75
E-mail	71	60	69	75
Staad	46	17	18	40
Primavera	60	14	15	30
MS Project	23	0	18	20
Prokon	16	46	49	45
3D Max	3	28	46	55
Photoshop	3	9	26	5

Respondents were asked to indicate method and/or software used to produce design drawings. The respondents offered 4 choices: manually, AutoCAD, Microstation, and other. Almost all firms use AutoCAD to produce design drawings. The respondents were further asked to indicate the percentage every method/software was used to produce the drawings. Fig. 4 shows that 94% of firms use AutoCAD (75-100%) of the time to produce design drawings.

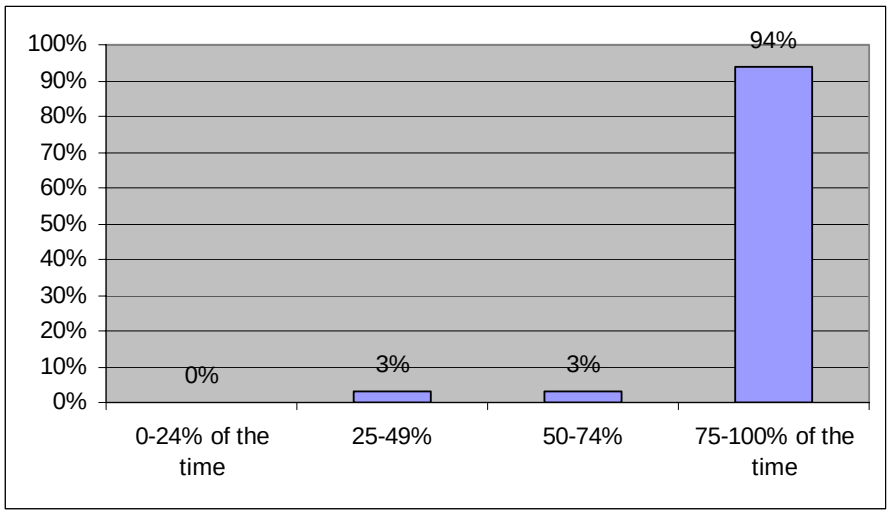

FIG.4:Frequency of AutoCAD use to produce design drawings

The respondents were asked to indicate the type of connection used by their firms to connect to the Internet. As shown in Fig. 5, 62% use a dial up modem, 29% use an ADSL, and 9% do not connect to the Internet.

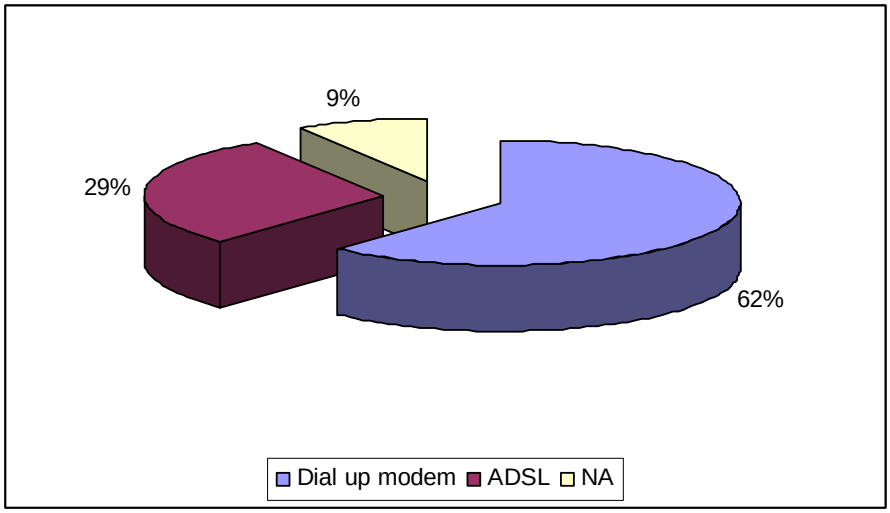

FIG. 5: Connecting to the Internet

The survey showed that only few firms have a web site and that more firms are planning to launch a web site in the next 2 years. Fig. 6 shows that only 15% of firms currently have a web site, 48% are planning to have a web site in the next 2 years, and 37% do not have a web site and are not planning to have one in the next 2 years.

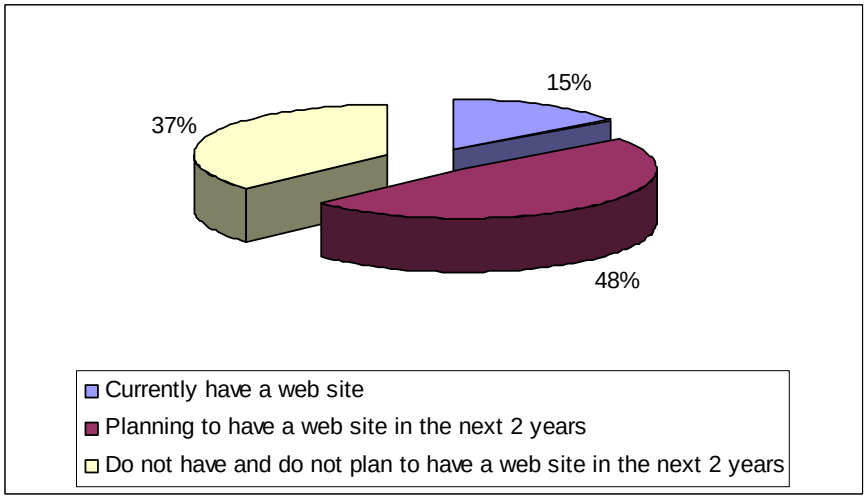

FIG. 6: Availability and plans regarding web sites

Table 3 shows that there are differences regarding web sites availability and plans within the industry groups. Currently, more consulting firms are having web sites compared to the rest of the industry. Almost half the consulting and architectural and engineering firms and about one-third of the rest of the industry do not have and do not plan to have a web site in the next 2 years.

TABLE 3: Availability and plans regarding web sites broken by types of firms (%)

	General Contractors	Architectural and Engineering Firms	Consulting and Architectural and Engineering Firms	Consulting Firms
Currently have a web site	21	7	10	35
Planning to have a web site in the next 2 years	46	58	41	30
Do not have and do not plan to have a web site in the next 2 years	33	35	49	35

Access to e-mail is not available to all employees as indicated by the survey. Fig. 7 shows that only 32% of firms provide e-mail access to over half of their employees, while 68% of firms provide e-mail access to less than half of their employees.

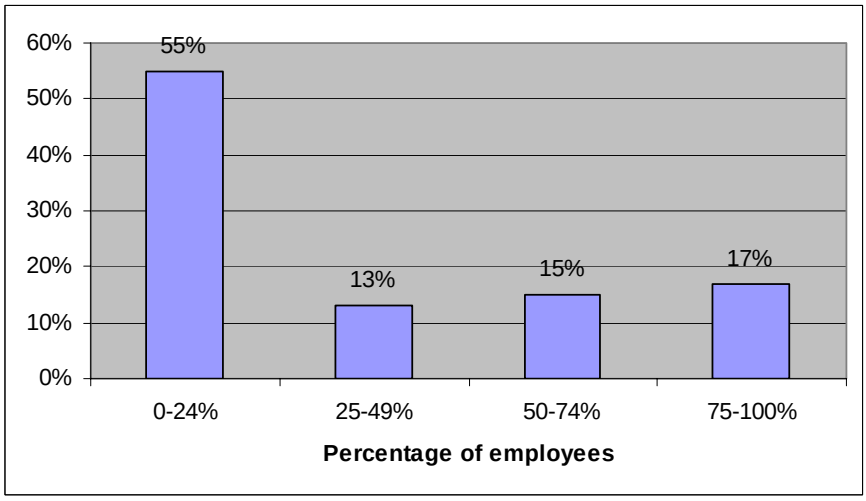

FIG. 7: Percentage of employees that have e-mail access

Table 4 shows percentage of employees that have e-mail access broken by types of firms. About one-third of consulting firms offer e-mail access to (75-100%) of their employees, while only 4% of general contractors offer e-mail access to (75-100%) of their employees. Eighteen percent of consulting and architectural and engineering firms and 23% of architectural and engineering firms offer e-mail access to (75-100%) of their employees.

TABLE 4: Percentage of employees that have e-mail access broken by types of firms (%)

% of Employees	General Contractors	Architectural and Engineering Firms	Consulting and Architectural and Engineering Firms	Consulting Firms
0-24%	55	55	62	45
25-49%	24	8	5	10
50-74%	17	14	15	10
75-100%	4	23	18	35

The survey shows similarity of availability of Internet access to that of e-mail access. Sixty percent of firms provide Internet access to less than half of their employees compared to 40% of firms offer such access for over half of their employees as shown in Fig. 8.

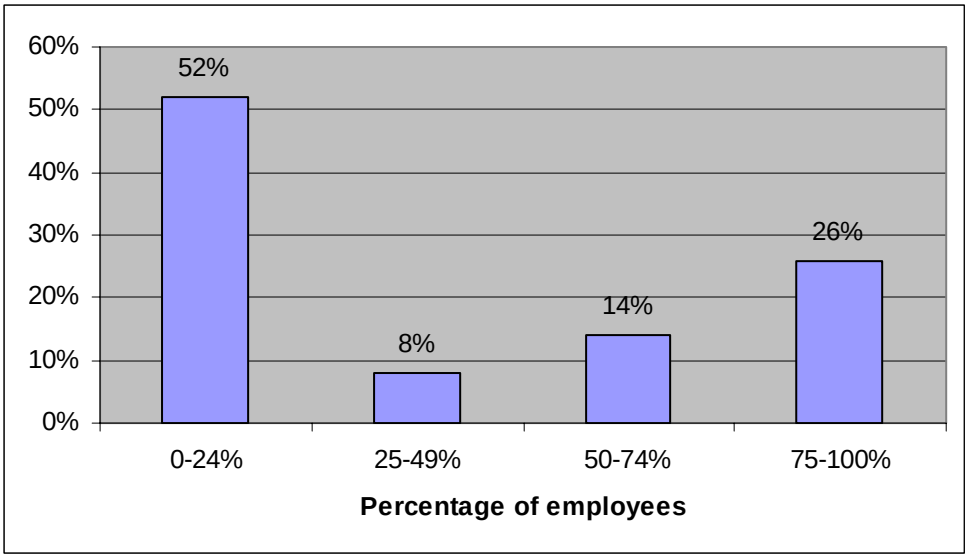

FIG. 8: Percentage of employees that have Internet access

Table 5 compares the percentages of employees that have Internet access between the different groups of the industry. Forty percent of consulting firms offer Internet access to (75-100%) of their employees, while only 14% of general contractors offer Internet access to (75-100%) of their employees. On the other hand, approximately one-third of the rest of the industry provide Internet access to (75-100%) of their employees.

TABLE 5: Percentage of employees that have Internet access broken by types of firms (%)

	General Contractors	Architectural and Engineering Firms	Consulting and Architectural and Engineering Firms	Consulting Firms
0-24%	56	52	54	45
25-49%	13	5	5	5
50-74%	17	14	8	10
75-100%	14	29	33	40

IT utilization has offered the opportunity to exchange documents electronically. Fig. 9 shows that meeting minutes, design documents, and calculations are sometimes exchanged electronically by over 40% of the

industry. Both construction documents and specifications are never exchanged electronically by over 50% of the industry.

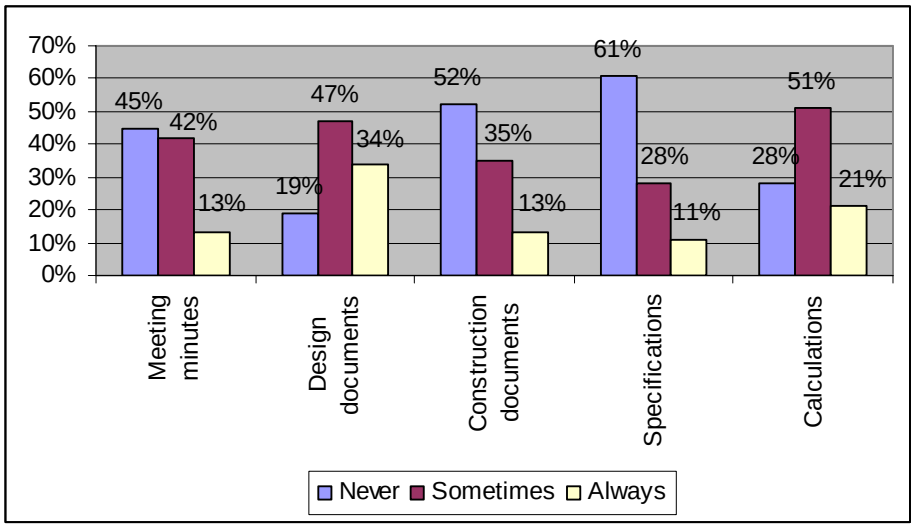

FIG. 9: Electronic exchange of documents

The industry is investing more dollars in IT. Eighty-two percent of firms have increased their IT investment in the past 2 years compared to merely 1% who have decreased their investment as shown in Fig. 10.

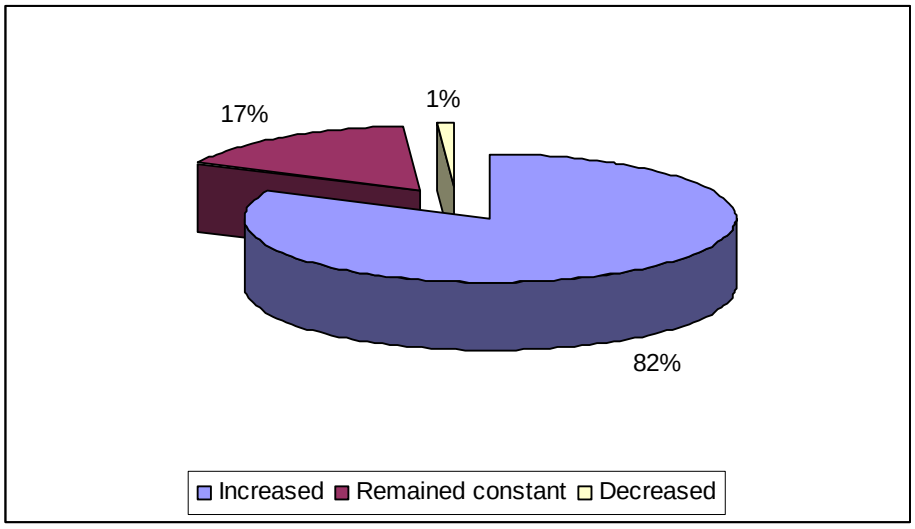

FIG. 10: IT investment in the past 2 years

Table 6 shows that the increase in IT investment in the past 2 years was a trend across the industry. This trend was exercised by the majority of firms.

TABLE 6: IT investment in the past 2 years broken by types of firms (%)

	General Contractors	Architectural and Engineering Firms	Consulting and Architectural and Engineering Firms	Consulting Firms
Increased	86	77	79	85
Remained constant	13	22	21	10
Decreased	1	1	0	0

Fig. 11 shows that the industry will continue to increase its IT investment. Eighty-five percent of firms are planning to increase their IT investment in the next 2 years.

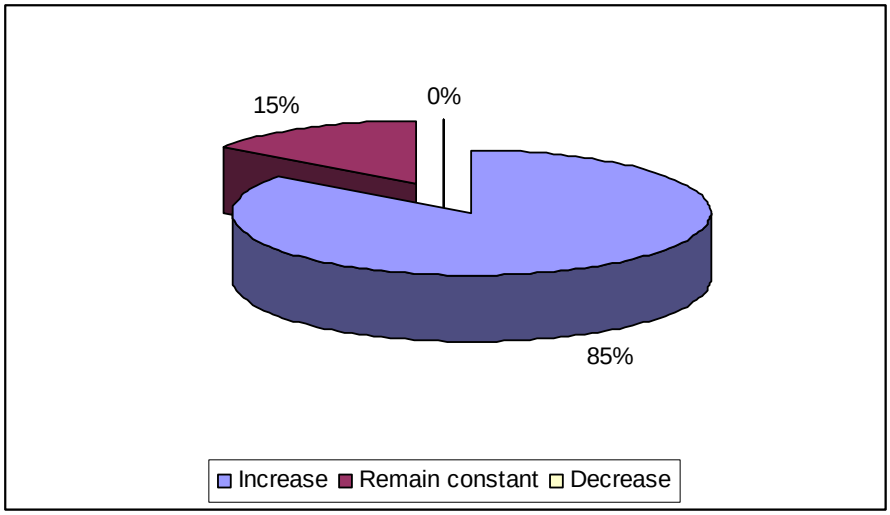

FIG. 11: IT investment in the next 2 years

A successful deployment of IT requires acceptance on the part of the employees of the industry. As shown in Fig. 12, 47% of firms reported active involvement of their staff, 43% experienced quick acceptance, 9% indicated slow acceptance, and only 1% faced resistance by their staff for greater IT use.

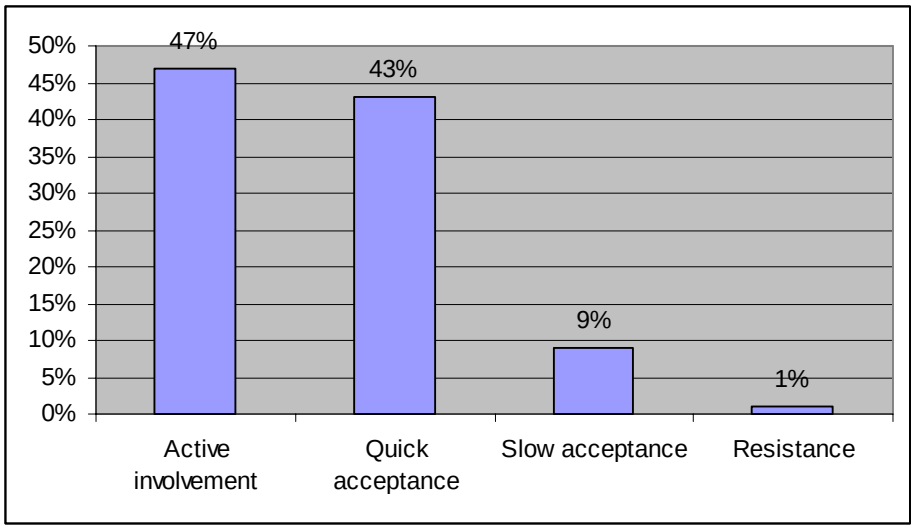

FIG. 12: Staff attitude towards greater IT use

Table 7 shows staff attitude towards greater IT use broken by types of firms. The staff of the consulting firms are much more involved in greater IT use compared to the rest of the staff of the industry. Ninety percent of the staff of consulting firms show active involvement attitude towards greater IT use compared to merely one-third of the staff of general contractors and approximatley half the staff of the rest of the industry.

TABLE 7: Staff attitude towards greater IT use broken by types of firms (%)

	General Contractors	Architectural and Engineering Firms	Consulting and Architectural and Engineering Firms	Consulting Firms
Active involvment	34	47	49	90
Quick acceptance	50	41	40	5
Slow acceptance	10	10	8	5
Resistance	0	2	3	0

The industry believes that IT has impacted the productivity of business activities. Fig. 13 shows that 67% of respondents believe that productivity of business administration has increased as a result of IT use compared to 33% of respondents who believe that the productivity of business administration has not changed. Ninety-seven percent of respondents believe that the productivity of design has increased compared to 3% only who believe that such productivity is unchanged. The productivity of project management has increased according to 81% of respondents, while 19% believe such productivity remains unchanged. None of the respondents believe that the productivity of business administration, design, or project management has declined as a result of IT use.

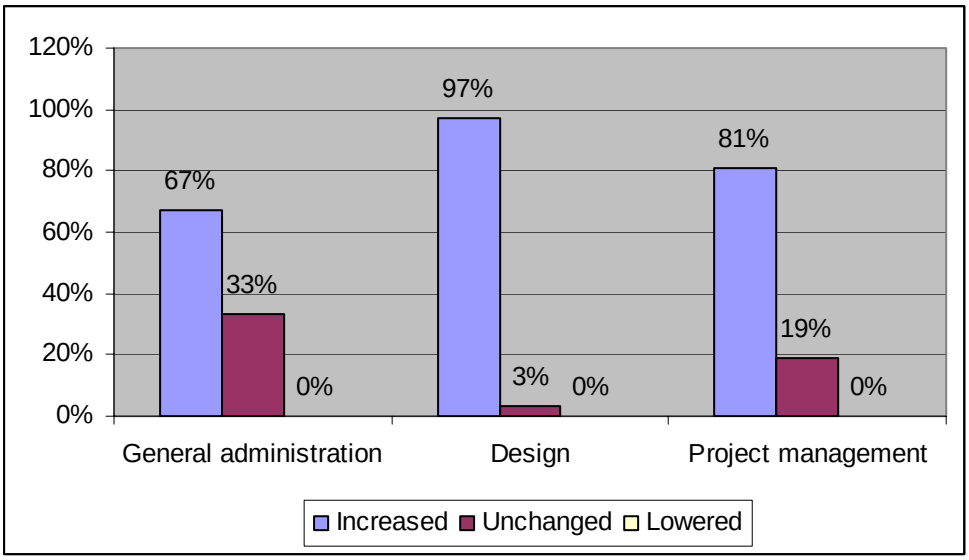

FIG. 13: IT impact on the productivity of business activities

Fig.14 shows IT impact on the productivity of business activities according to general contractors. Almost all general contractors indicate that the productivity of general administration, design, and project management have increased as a result of IT use.

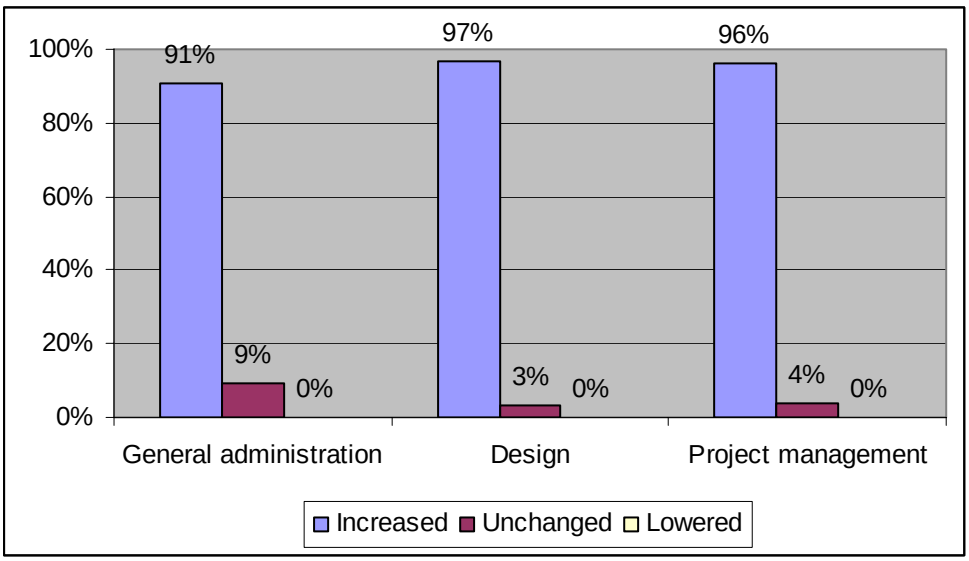

FIG. 14: IT impact on the productivity of business activities according to general contractors

According to 96% of architecture and engineering firms, productivity of design has increased from IT use as shown in Fig. 15. On the other hand, 70% and 54% of architecture and engineering firms indicated that the productivity of general administration and project management respectively have increased as a result of IT use.

Fig. 16 shows that all consulting firms believe that productivity of design has increased as a result of IT use. Seventy-four percent and 90% of consulting firms believe that the productivity of business administration and project management respectively have increased as a result of IT use.

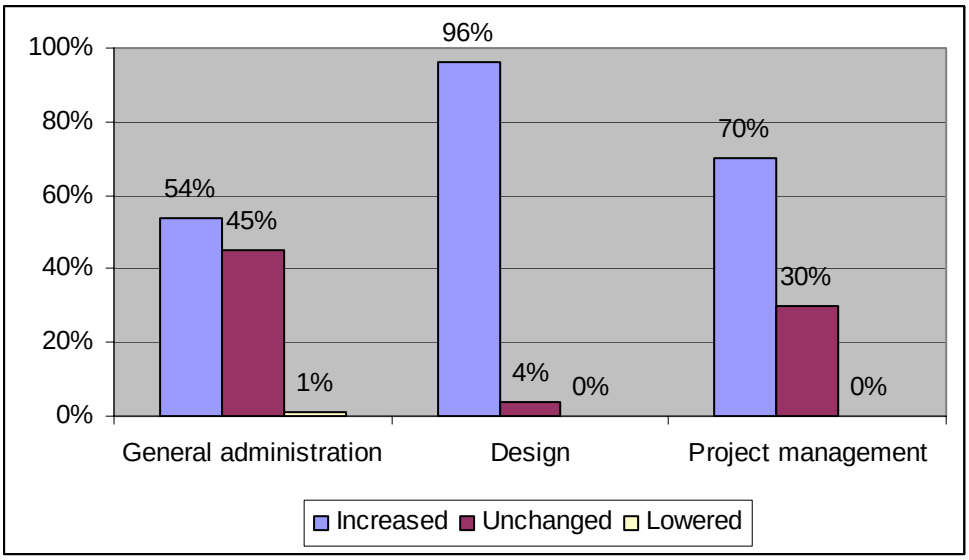

FIG. 15: IT impact on the productivity of business activities according to architectural and engineering firms

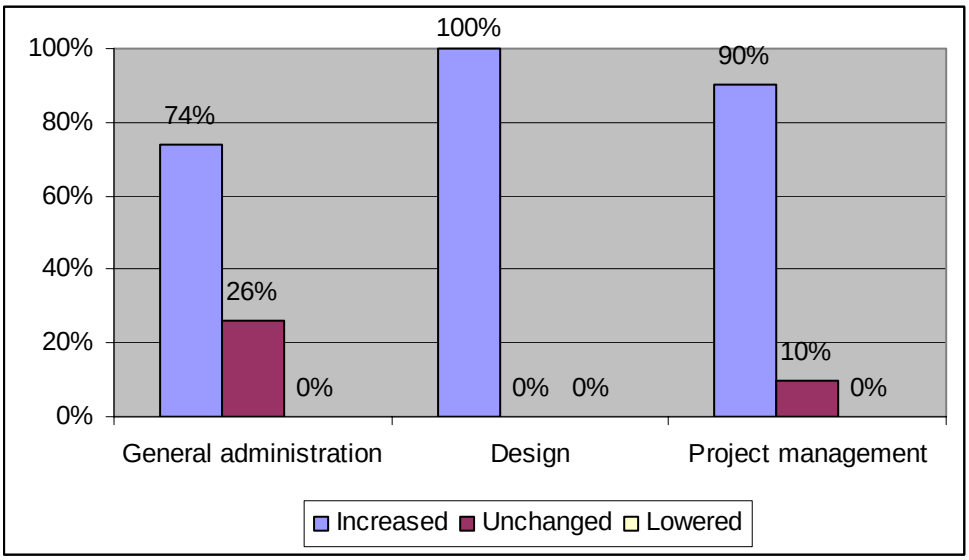

FIG. 16: IT impact on the productivity of business activities according to consulting firms

Fig. 17 shows the importance of motivations for using IT. Ninety-two percent of respondents rate demand from customers as a very important motivation for using IT. Efficiency of technical work, means of competition, demands from employees, and boost the image of the company are rated very important motivations for using IT by over 60% of the respondents.

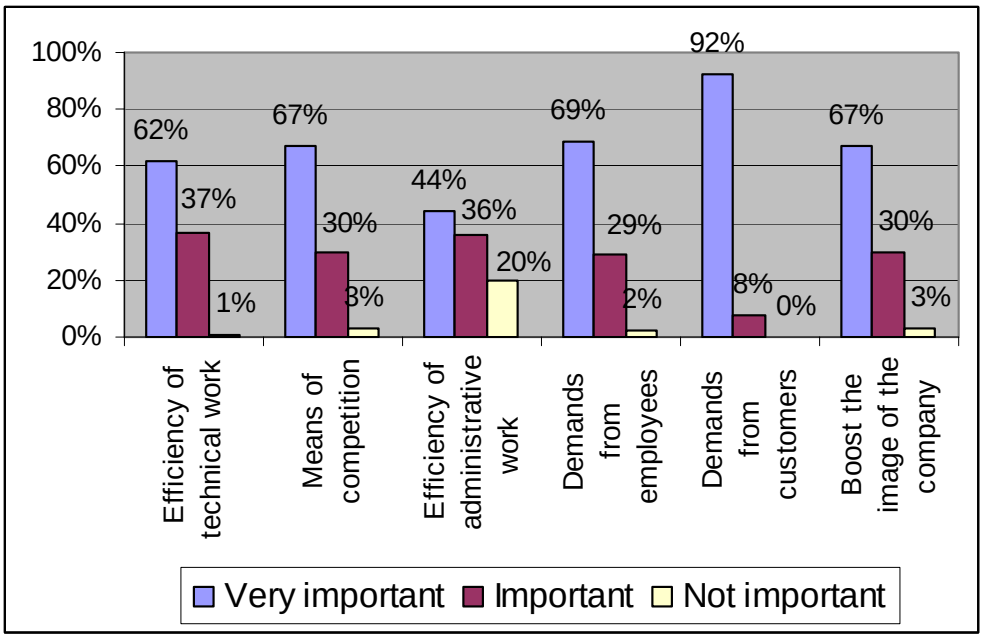

FIG. 17: Motivations for using IT

The introduction of IT resulted in changes to mistakes in documentation, document quality, speed of work, complexity of work, proportion of new operations, and costs of doing business. As shown in Fig. 18, almost all respondents indicated that both document quality and speed of work are higher as a result of the introduction of IT. About half the respondents believe that proportion of new operations and costs of doing business are higher as a result of IT introduction.

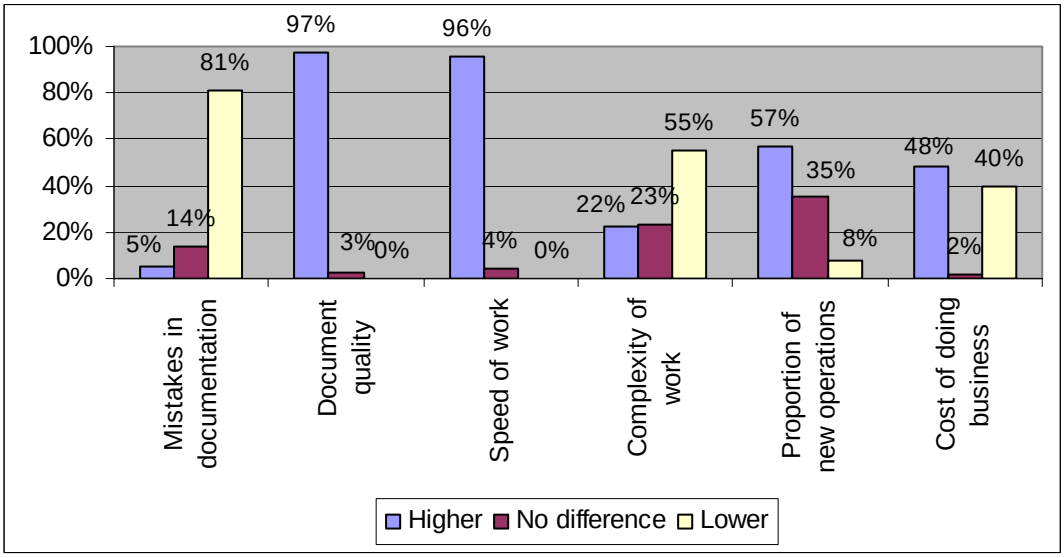

FIG. 18: Changes caused by the introduction of IT

Respondents were asked to indicate their view of the main benefits of IT adoption. Table 8 shows that over 80% of respondents agree that the following are main benefits of IT adoption: better quality of work, work done more quickly, better financial control, better communications, faster and simpler access to common data, greater felxibility to satisfy customers, possibility of sharing common information, easier to use lots of data, and possibility of telecommuting.

TABLE 8: Main benefits of IT adoption (%)

	Strongly Disagree	Slightly Disagree	Slightly Agree	Strongly Agree
Better quality of work	1	3	26	70
Work done more quickly	0	5	34	61
Better financial control	1	13	53	33
Better communications	0	6	61	33
Faster and simpler access to common data	0	13	57	30
Greater felxibility to satisfy customers	0	3	36	61
Possibility of sharing common information	1	13	62	24
Easier to use lots of data	1	16	62	21
Possibility of telecommuting	1	11	67	21
Possibility of reducing staff	15	34	45	6
Less use of paper	22	28	40	10

Main obstacles for greater use of IT include continual demand for upgrading, investment costs too high, greater know-how required from staff, risk that IT leads to inefficiency, the old ways work well, and lack of commitment from management. Table 9 shows the responses to those obstacles. Approximately half the respondents strongly agree that one of the obstacles to greater use of IT is that investment costs too high. The majority of the respondents slightly agree that greater know-how required from staff is one of the obstacles to greater use of IT.

TABLE 9: Obstacles to greater use of IT (%)

	Strongly Disagree	Slightly Disagree	Slightly Agree	Strongly Agree
Continual demand for upgrading	4	10	4	39
Investment costs too high	2	8	41	49
Greater know-how required from staff	2	17	68	13
Risk that IT leads to inefficiency	10	30	50	10
The old ways work well	24	47	24	5
Lack of commitment from management	14	39	42	5

4. CONCLUSIONS

This paper reports the findings of conducting a modified version of the IT barometer survey in the construction, architecture and engineering, and consulting industry in Jordan. The study collects data from 207 firms. These firms were interviewed during the period of June 2004 and January 2005. Thirty-four percent of the participating firms are general contractors, 37% are architecture and engineering firms, 19% are consulting and architecture and engineering firms, and 10% are consulting firms. The participating firms are involved in the construction of buildings, roads and bridges, water and sewage projects, and electromechanical projects.

The study shows that there is a 0.46 desktop computer and a 0.024 laptop computer per employee. Among the top software utilized by the industry are Word, Excel, web browsers, and e-mail. AutoCad dominates the production of engineering drawings with most firms utilize the software almost 100% of the time. Only 15% of firms have a website, 48% are planning to have a website in the next two years, and 37% do not plan to have a website. Eighty-two percent of firms have increased their IT investment in the last two years. Eighty-five percent are committing more dollars to invest in IT in the next two years. Demands from customers is one of the top motivators for new IT investment. Forty-seven percent of firms report active involvement of their employees in IT deployment and implementation.

IT has a positive impact on the productivity of business activities. Over 80% of respondents believe that the introduction of IT has improved the productivity of design and project management. Two-thirds of the respondents agree that the productivity of general administration has improved as a result of IT introduction. Almost all respondents indicated that IT has improved the quality of documents and increased the speed of work. The perceived benefits for IT adoption according to the respondents are better quality of work, work done more

quickly, better financial control, better communications, faster and simpler access to common data, greater felxibility to satisfy customers, possibility of sharing common information, easier to use lots of data, and possibility of telecommuting. The main obstacles for IT use are investment costs too high and greater know-how required from staff.

The study benchmarks current IT usage, availability, and perceived impact in the construction, architecture and engineering, and consulting industry in Jordan. Such benchmarking is of prime importance to both construction education and practice to understand current trends, forecast future directions, and conduct international comparisons.

5. ACKNOWLEDGMENTS

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